REMARKS

Claims 1-22 are pending. Claims 12 and 14 are rejected under 35 U.S.C. § 102(e). Claims 1-11, 13, 15-22 are rejected under 35 U.S.C. § 103(a).

Examiner objects to Figures 1-2 of the drawings as not being designated "Prior Art." Applicants have included a marked up sheet (Annotated Sheet) indicating Figures 1-2 are Prior Art. Applicants have also included a "Replacement Sheet" indicating Figures 1-2 are Prior Art.

Independent claim 12 is rejected under 35 U.S.C. § 102(e) as being anticipated by Foerster et al. (US 2004/0047285 A1). Examiner states that Foerster et al. teach a UWB transmitter generating time-frequency interleaved (TFI) orthogonal frequency division multiplexed (OFDM) signals. Applicants respectfully disagree. Forester et al. teach an *impulse-based* UWB transmitter where the impulses are interleaved in frequency and time. Therein, coded information after the DAC (Figure 2) is used to modulate an impulse waveform. This impulse waveform is designed such that its 10-dB bandwidth is greater than 500 MHz as stated in paragraph [0013]. Therein, Foerster et al. state:

> In the example shown in Fig. 1, six *impulse radio* ultra-wideband (IR-UWB) *waveforms may be generated using an impulse having, for example, a 500 MHz bandwidth* having a center frequency that may vary between 3 and 6 GHz, although the scope of the invention is not limited in this respect. (emphasis added).

Forester et al. also teach in paragraph [0014] that the bandwidth of the sub-band is inversely proportional to the duration of the impulse waveform. In particular, Foerster et al. state "as the duration of the impulse waveform increases, as the bandwidth of the sub-bands decreases, the transmitted waveform may be continuous in time and may begin to resemble an OFDM waveform." Therefore, bandwidth of each of the sub-bands $S_i(f)$ in Figure 2 is generated by using an impulse waveform with appropriate duration, typically on the order of a few nanoseconds.

By way of contrast, the bandwidth of a TFI-OFDM signal is achieved in a preferred embodiment of the present invention by using a 128-point FFT in the sub-banded case, where the tone spacing of the FFT is 4.125 MHz. Data is carried on 122 tones. This preferably includes 100 data sub-carriers, 12 pilot sub-carriers, and 10 guard sub-carriers. Therefore, the bandwidth of the TFI-OFDM signal within a single sub-band is 122*4.125 MHz = 503.25 MHz. Thus, the bandwidth of the signal within a sub-band is created by using an IFFT with appropriate tone spacing and NOT by using an impulse waveform. Note that in the case of the TFI-OFDM system, the inverse of the symbol length does not correspond to the bandwidth of the signal (1/312.5 ns = 3.2 MHz). This is very different from the impulse-radio system described by Foerster et al. These features of the present invention are described in detail in paragraphs [0077]-[0082].

Finally, Foerster et al. specifically state that when the system is reduced to a single sub-band, that it becomes a typical impulse-radio (IR) UWB system as described in paragraph [0016]. In contrast, if the TFI-OFDM system is reduced to a single sub-band, it becomes a typical or traditional OFDM system, which is very different from a traditional OFDM system and cannot be confused with a tradition IR-UWB system. They are completely different technologies. Thus, independent claim 12 and depending claim 14 are patentable under 35 U.S.C. § 102(e). Moreover, claim 13 is patentable under 35 U.S.C. § 103(a), as depending from patentable claim 12.

Independent claim 1 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Foerster et al. in view of Tewfik et al. (US 2004/0005016 A1). Independent claim 1 recites "An ultra-wide-band (UWB) physical layer using time-frequency interleaved (TFI) orthogonal frequency division multiplexing (OFDM) within the 3.1 – 10.6 GHz UWB band." As previously discussed with regard to claim 12, Foerster et al. do not disclose a TFI-OFDM physical layer. Thus, claim 1 and depending claims 2-11 are patentable under 35 U.S.C. § 103(a).

Independent claim 15 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Foerster et al. in view of Barton et al. (US 2004/0005016 A1). Independent claim 15 recites "A

modulation scheme for ultra-wideband (UWB) systems, the scheme comprising the method steps of: providing a UWB physical layer operational to generate orthogonal frequency division multiplexed (OFDM) symbols within a desired band; *interleaving the OFDM symbols across both time and frequency to divide the desired band into smaller sub-bands*; and *inserting a guard interval after each OFDM symbol*, such that the UWB physical layer has sufficient time to switch from its current channel to the next channel." (emphasis added). As previously discussed with regard to claim 12, Foerster et al. do not disclose a TFI-OFDM transmitter according to the previous invention. In particular, Foerster et al. do not disclose "interleaving the OFDM symbols across both time and frequency to divide the desired band into smaller sub-bands."

Regarding a combination with Barton, there appears to be some confusion as to the terminology between guard interval and cyclic prefix. Barton et al. defines a *guard interval* to be composed of some cyclic prefix samples and some cyclic postfix samples. These samples are cyclic extensions of the OFDM symbol and therefore are a function of the IFFT output. For example, a cyclic prefix is created by copying the last N samples from the IFFT output and pre-appending then to the IFFT output to create the OFDM symbol. Similarly, the cyclic postfix is created by appending the first N samples from the IFFT output to the end of the IFFT output.

The TFI-OFDM system of the present invention uses both a cyclic prefix as defined above, and also uses a guard interval which is different from either a cyclic prefix or a cyclic postfix. The guard interval is composed of zero samples as described at paragraph [0146]. The guard interval is not a function of the IFFT output, as it is in the description provided by Barton et al. Therefore, Barton et al. does not teach a guard interval as required by claim 15. Thus, claim 15 and depending claims 16-22 are patentable under 35 U.S.C. § 103(a).

In view of the foregoing, applicants respectfully request reconsideration and allowance of claims 1-22. If the Examiner finds any issue that is unresolved, please call applicants' attorney by dialing the telephone number printed below.

Respectfully submitted,

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TI-35949 ANNOTATED SHEET

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FIG. 1 (PRIOR ART)

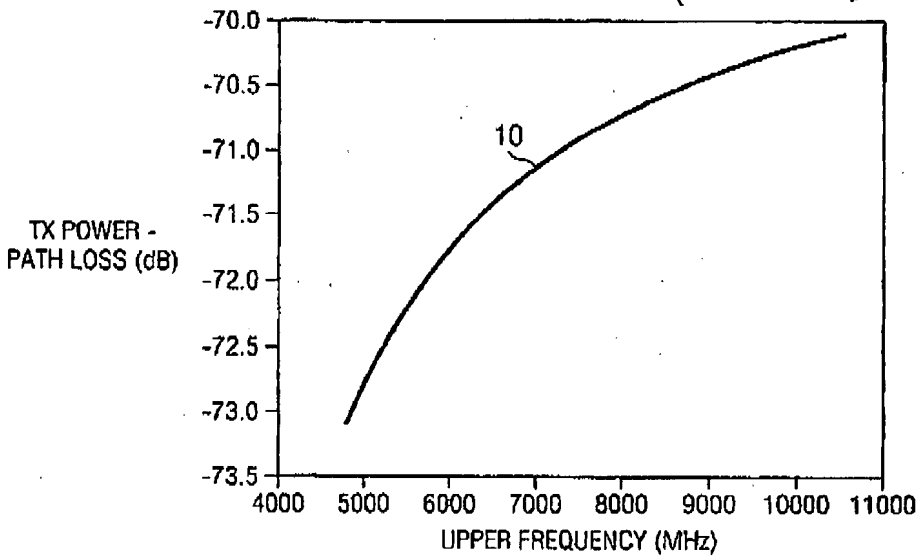

FIG. 2 (PRIOR ART)

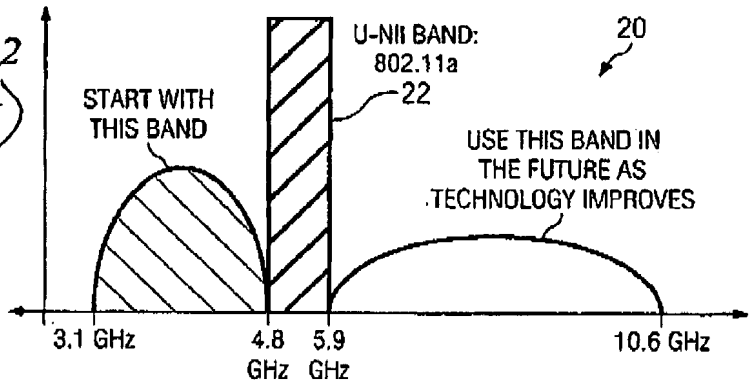

FIG. 3